CLAIMS

1. Method for configuring a Trie-type associative memory for the processing of data packets based on a set of rules, the Trie memory being used for analyzing binary strings situated at defined locations in each data packet, whereby each rule attributes an action to a packet based on the values of the binary strings, wherein the Trie memory includes registers made up of a defined number of individual cells for receiving respective references, the method comprising the steps of:

a- translating the set of rules into a packet analysis tree, comprising nodes distributed into successive stages respectively associated with the locations considered in a defined order, arcs and leaves corresponding to actions which can be attributed by the rules, the first stage of the tree comprising a single node called root node of the analysis tree,

each arc having a start node and an arrival point consisting either of a node of the stage following that of said start node or of a leaf, and being associated with a respective domain of binary string values possible at said location,

the analysis tree defining paths each consisting of a series of n arcs, n being an integer at least equal to 1, the first arc of the series having as start node the root node of the analysis tree,

the arrival point of each arc of a path other than the last arc being the start node of the following arc of said path, and the arrival point of the last arc of the path being a leaf corresponding to an action attributed according to the set of the rules to each packet having, at the n

locations associated respectively with the stages of the start nodes of the n arcs of said path, binary string values falling into the n domains associated respectively with said arcs;

b- allocating a group of registers of the Trie memory, including a gatekeeper register, to each node of the analysis tree belonging to a stage associated with a location, and recording references in the cells of the group of registers such that, by analyzing from the gatekeeper register the binary string value contained at said location in a packet, a final reference is obtained depending on which domain contains the value from among the domains of values associated with the arcs having said node as start node and such that:

if the arc associated with the domain containing the value has, as arrival point, a leaf corresponding to an action, the final reference designates the action as being attributed to the packet, and

if the arc associated with the domain containing the value has another node of the following stage as arrival point, the final reference designates said other node so as to carry on by analyzing the binary string value contained in the packet at the location associated with said following stage.

2. Method according to Claim 1, further comprising the steps of:

i- for each one of the locations, determining consecutive elementary intervals covering binary string values possibly appearing at said one of the locations, each elementary interval being such that the action attributed by each of the

rules is not altered by a change, within said elementary interval, of the value of the binary string situated at said location in a processed packet; and

ii- counting the elementary intervals determined for each location,

wherein said defined order of the locations is such that the location for which the largest number of elementary intervals has been determined is placed last.

3. Method according to Claim 2, wherein said order of the locations is defined by sorting the locations in order of increasing numbers of elementary intervals.

4. Method according to Claim 2, wherein the elementary intervals determined for each location comprise interval bounds, and wherein each interval bound corresponds to the change of an action which can be attributed by at least one rule.

5. Method according to Claim 1, wherein the step of translating the set of rules is such that at least one node of the analysis tree is the arrival point of a plurality of arcs originating from distinct start nodes of the preceding stage.

6. Method according to Claim 1, wherein a sub-tree is associated with each node of the analysis tree other than the root of the analysis tree, said sub-tree having a root constituted by said node and being made up of the nodes, arcs and leaves encountered from said node along the paths passing through said node, and wherein the step of translating the set of rules is such that the analysis tree does not include any first and second sub-trees having distinct roots and such that the respective nodes, arcs and leaves of said first and second sub-trees can be paired so that each

node of the first sub-tree is paired with a node of the second sub-tree belonging to a same stage, that each leaf of the first sub-tree is paired with a leaf of the second sub-tree corresponding to a same action, and that two arcs paired of the first and second sub-trees have start nodes which are paired together and arrival nodes which are paired together, and are associated with the same domain of values.

7. Method according to Claim 1, wherein each rule of the set is defined by an action and by ranges of values corresponding to at least some of the locations, and attributes the action to the packets having, at said at least some of the locations, binary string values falling into the respective ranges.

8. Method according to Claim 7, further comprising the step of associating a subset of rules with each node of a (p+1)-th stage of the analysis tree, p being an integer greater than 0, said subset being composed of the rules of the set such that each range of values corresponding to a location associated with one of the p first stages of the tree has a non-empty overlap with the domain of values associated with the arc of each path passing through said node and having a start node in said stage.

9. Method according to Claim 8, wherein a subset consisting of the set of the rules is associated with the root node, and wherein the translation of the set of rules comprises the following steps for each node of the p-th stage associated with a first subset of rules:

- determining domains of values covering binary string values possibly appearing at the p-th location considered in said order, whereby each domain is such that the action attributed by each of the rules of the first subset is not altered

by a change, within said domain, of the value of the binary string situated at the p-th location in a processed packet; and

- for each of said domains of values :
  - generating an arc associated with said domain, having said node of the p-th stage as start node;
  - detecting each rule of the first subset which is defined by at least one range of values including said domain;
  - if no rule detected, assigning a leaf of the tree corresponding to a default action as arrival point of said arc;
  - if, for each detected rule, no range of values corresponds to any one of the locations following the p-th location in said order, assigning a leaf of the tree corresponding to an action of a detected rule as arrival point of said arc;
  - if, for at least one detected rule, a range of values corresponds to one of the locations following the p-th location in said order, attributing a node of the (p+1)-th stage of the tree as arrival point of said arc, said node of the (p+1)-th stage being associated with a second subset composed of the detected rules of the first subset.

10. Method according to Claim 9, wherein priorities are respectively assigned to the rules of the set, and wherein, when a plurality of rules are detected and none of the ranges of values of said plurality of rules corresponds to one of the locations following the p-th location, the action corresponding to the leaf of the tree attributed to said arc is the action of one of

said plurality of rules, selected on the basis of the assigned priorities.

11. Method according to Claim 9, further comprising the following steps when at least one rule is detected having a range of values corresponding to one of the locations following the p-th location:

- searching whether a node of the (p+1)-th stage of the tree associated with the second subset has already been generated;
- if the search fails, generating such node in the (p+1)-th stage;
- if the search identifies a node of the (p+1)-th stage, attributing the identified node as arrival point of said arc.

12. A device for processing data packets, comprising a Trie-type associative memory for the analysis of binary strings situated at defined locations in each data packet, and a controller for configuring the Trie memory for the processing of the data packets on the basis of a set of rules, whereby each rule attributes an action to a packet based on values of the binary strings, the Trie memory including registers made up of a defined number of individual cells for receiving respective references, wherein the controller comprises:

a- means for translating the set of rules into a packet analysis tree, comprising nodes distributed into successive stages respectively associated with the locations considered in a defined order, arcs and leaves corresponding to actions which can be attributed by the rules, the first stage of the tree comprising a single node called root node of the analysis tree,

each arc having a start node and an arrival point consisting either of a node of the stage

following that of said start node or of a leaf, and being associated with a respective domain of binary string values possible at said location,

the analysis tree defining paths each consisting of a series of n arcs, n being an integer at least equal to 1, the first arc of the series having as start node the root node of the analysis tree,

the arrival point of each arc of a path other than the last arc being the start node of the following arc of said path, and the arrival point of the last arc of the path being a leaf corresponding to an action attributed according to the set of the rules to each packet having, at the n locations associated respectively with the stages of the start nodes of the n arcs of said path, binary string values falling into the n domains associated respectively with said arcs;

b- means for allocating a group of registers of the Trie memory, including a gatekeeper register, to each node of the analysis tree belonging to a stage associated with a location, and for recording references in the cells of the group of registers such that, by analyzing from the gatekeeper register the binary string value contained at said location in a packet, a final reference is obtained depending on which domain contains the value from among the domains of values associated with the arcs having said node as start node and such that:

if the arc associated with the domain containing the value has, as arrival point, a leaf corresponding to an action, the final reference designates the action as being attributed to the packet, and

if the arc associated with the domain containing the value has another node of the following stage as arrival point, the final reference designates said other node so as to carry on by analyzing the binary string value contained in the packet at the location associated with said following stage.

13. Device according to Claim 12, wherein the data packets comprise ATM cells carrying AAL 5 frames.

14. Device according to Claim 12, wherein the data packets comprise IP packets.

15. Device according to Claim 12, arranged for the routing, by a communications network, of data packets on the basis of routing rules applied to said packets.

16. Device according to Claim 12, arranged for the control of access to a communications network by data packets on the basis of access control rules applied to said packets.

17. Device according to Claim 12, arranged for the acquisition of information relating to data packets transmitted by a communications network.

18. Device according to Claim 12, wherein the controller further comprises:

i- means for determining consecutive elementary intervals for each one of the locations, wherein each of said elementary intervals covers binary string values possibly appearing at said one of the locations, each elementary interval being such that the action attributed by each of the rules is not altered by a change, within said elementary interval, of the value of the binary

string situated at said location in a processed packet; and

ii- means for counting the elementary intervals determined for each location,

wherein said defined order of the locations is such that the location for which the largest number of elementary intervals has been determined is placed last.

19. Device according to Claim 18, wherein said order of the locations is defined by sorting the locations in order of increasing numbers of elementary intervals.

20. Device according to Claim 18, wherein the elementary intervals determined for each location comprise interval bounds, and wherein each interval bound corresponds to the change of an action which can be attributed by at least one rule.

21. Device according to Claim 12, wherein the means for translating the set of rules are so arranged that at least one node of the analysis tree is the arrival point of a plurality of arcs originating from distinct start nodes of the preceding stage.

22. Device according to Claim 12, wherein a sub-tree is associated with each node of the analysis tree other than the root of the analysis tree, said sub-tree having a root constituted by said node and being made up of the nodes, arcs and leaves encountered from said node along the paths passing through said node, and wherein the means for translating the set of rules are so arranged that the analysis tree does not include any first and second sub-trees having distinct roots and such that the respective nodes, arcs and leaves of said first and second sub-trees can be paired so that each node of the first sub-tree is paired with a node of the

second sub-tree belonging to a same stage, that each leaf of the first sub-tree is paired with a leaf of the second sub-tree corresponding to a same action, and that two arcs paired of the first and second sub-trees have start nodes which are paired together and arrival nodes which are paired together, and are associated with the same domain of values.

23. Device according to Claim 12, wherein each rule of the set is defined by an action and by ranges of values corresponding to at least some of the locations, and attributes the action to the packets having, at said at least some of the locations, binary string values falling into the respective ranges.

24. Device according to Claim 23, wherein the controller further comprises means for associating a subset of rules with each node of a (p+1)-th stage of the analysis tree, p being an integer greater than 0, said subset being composed of the rules of the set such that each range of values corresponding to a location associated with one of the p first stages of the tree has a non-empty overlap with the domain of values associated with the arc of each path passing through said node and having a start node in said stage.

25. Device according to Claim 24, wherein a subset consisting of the set of the rules is associated with the root node, and wherein the means for translating the set of rules comprise:

- means for determining, for each node of the p-th stage associated with a first subset of rules, domains of values covering binary string values possibly appearing at the p-th location considered in said order, whereby each domain is such that the action attributed by each of the rules of the first subset is not altered by a change,

within said domain, of the value of the binary string situated at the p-th location in a processed packet;

- means for generating an arc associated with each one of said domains of values, having said node of the p-th stage as start node;
- means for detecting each rule of the first subset which is defined by at least one range of values including said one of the domains;
- means for assigning a leaf of the tree corresponding to a default action as arrival point of said arc if no rule detected;
- means for assigning a leaf of the tree corresponding to an action of a detected rule as arrival point of said arc if, for each detected rule, no range of values corresponds to any one of the locations following the p-th location in said order; and
- means for attributing a node of the (p+1)-th stage of the tree as arrival point of said arc if, for at least one detected rule, a range of values corresponds to one of the locations following the p-th location in said order, said node of the (p+1)-th stage being associated with a second subset composed of the detected rules of the first subset.

26. Device according to Claim 25, wherein priorities are respectively assigned to the rules of the set, and wherein the means for assigning a leaf of the tree corresponding to an action of a detected rule comprise means for selecting said detected rule on the basis of the assigned priorities when a plurality of rules are detected and none of the ranges of values of said plurality of rules corresponds to one of the locations following the p-th location.

27. Device according to Claim 25, wherein the means for attributing a node of the (p+1)-th stage of the tree as arrival point of said arc comprise

- means for searching whether a node of the (p+1)-th stage of the tree associated with the second subset has already been generated;
- means for generating such node in the (p+1)-th stage if the search fails; and
- means for, if the search identifies a node of the (p+1)-th stage, attributing said identified node as arrival point of said arc.